PATENT SPECIFICATION 962,430

DRAWINGS ATTACHED.

962,430

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COMPLETE SPECIFICATION.

Improvements in or relating to Propeller Driven, Fixed-Wing Convertible Aircraft.

We, AERO-CONSULTOR A.-G., a Body Corporate organised under the laws of Switzerland, of 20 Brüschrain, Zug, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns a propeller driven, fixed-wing convertible aircraft, which term designates an aircraft the lifting power of which may selectively be produced by means of the fixed lifting wings alone, or entirely or partly by means of direct propeller thrust, whereby optimum conditions for the normal flight are provided, and also the possibility is produced of affording a short or vertical take-off and hovering flight.

Previous proposals for aircraft of this type provide pivotable driving engines which, according to their angular position, either alone or together with the con-currently pivoting wings, serve for generating forward propulsion power and/or lifting power. The structural design of these known proposals, however, is extremely complicated. The weight and volume of the driving units to be pivoted are undesirably large and cause suspension and balancing problems which can be solved only with difficulties.

It is an object of the present invention to avoid the drawbacks of known propeller driven convertible aircraft. Accordingly the invention provides a propeller driven fixed-wing convertible aircraft comprising a fixed driving unit to which three propeller units are operatively connected, said propeller units being mounted for tilting movements in parallel planes with the pivoting points of said propeller units forming a triangle, which for all normal flight altitudes of the aircraft, lies in a plane situated above the centre of gravity of the aircraft, said plane being intersected within said triangle by an upwardly extending plumb line through the centre of gravity.

The described arrangement only requires relatively light weights to be tilted, the mounting of which above the centre of gravity of the aircraft results not only in favourable stability conditions, but also affords sufficiently free space above the ground for the propellers during a vertical take-off without requiring undesirably high carriage frames. The three propellers are conveniently so arranged that in normal flight one of them acts as tractive propeller while the other two are pusher propellers.

In a preferred form of construction an upwardly pivotable tractive propeller is provided, while on each of the two wings a downwardly pivotable pusher propeller is arranged.

When the tractive propeller is swung upwardly, it cannot be avoided, even with a high-wing construction, that the plane of the propeller will be situated above the plane of the wings. In certain cases the downflow of the tractive propeller tilted upwards for the hovering flight can partly impinge on the wings. It has been shown that this condition entails considerable losses in lifting power, and may also result in undesirable oscillation of the wings. In order to avoid this disadvantage the aircraft is provided with a tractive propeller having its pivoting axis siutated at such a distance ahead of the leading edge of the wing that the downflow of air from the tractive propeller can practically not impinge on the wings when it is in any upwardly disposed position.

The present invention will now be des-

[*Price* 4*s.* 6*d.*]

cribed in more detail with reference to the accompanying drawings illustrating, by way of example, two embodiments of the invention, and in which:—

Figure 1 is a view in elevation of an aircraft according to the invention;

Figure 2 shows a plan view of this aircraft;

Figure 3 is a front view thereof;

Figure 4 is a rear view of the aircraft;

Figure 5 is a view in elevation of a modified aircraft according to the invention.

The high-wing convertible aircraft according to Figures 1—4 has a box-shaped fuselage 1 with a carriage frame 2*a* and a tail wheel 2*b*. The two fixed wings extend from the top side of the fuselage. Two identical turbine operating driving engines 5 are mounted side by side on the top of the fuselage between the root ends of the wings. The engines are operatively connected to a common gear 4 to which are coupled three drive shafts 6 extending each to a propeller unit 7*a*, 7*b* and 7*c*, respectively, to which they are connected by appropriate articulated joint couplings. The propeller unit 7*a* is situated above the nose 1*a* of the fuselage and has a tractive propeller 8*a*, the axis of which is situated during normal flight in the plane formed by the vertical and longitudinal axes of the airplane. The two propeller units 7*b* and 7*c* are anchored each to one of the wings 3, through which the drive shafts also extend and are equipped with pusher type propellers 8*b* and 8*c* respectively.

The pivoting points of the propeller units 7*a*, 7*b* and 7*c*, which are tiltable in parallel planes, are designated by *x* in Figs. 1 and 2; these pivoting points form a triangle situated in a plane extending some distance above the centre of gravity S of the aircraft as a whole. An upwardly extending line *y* from the centre of gravity intersects this plane within the said triangle. The casing of the engines 5 is forwardly extended up to the propeller unit 7*a*, and rearwardly extended to form a tail unit carrier 9 projecting beyond the fuselage. It is thus possible to adapt the length of the tail unit carrier 9 with regard to the length of the fuselage in such manner as to obtain the largest possible landing angle. Moreover, the main entrance to the fuselage may easily be provided at the rear owing to the position of the tail unit, situated high above the free rear part 1*b* of the fuselage.

For starting the described aircraft, the forward propeller unit 7*a* with the tractive propeller 8*a* is upwardly swung through an angle 90°, while the two propeller units 7*b* and 7*c* together with their pusher propellers are downwardly swung through 90°. Position and power output of these units are selected so that vertical take-off and hovering flight will be possible; the arrangement is such that the three propellers are at least approximately equally loaded. For normal flight the propeller units are swung back to their position in which the propeller axes are horizontal.

The high-wing convertible aircraft according to Figure 5 again has box-shaped fuselage 1 with a landing gear 2*a* and a tail wheel 2*b*. The two rigid wings 3 begin at the top side of the fuselage. Two identical turbine operated driving units 5 arranged side by side are operatively connected to a common gear 4 on the top of the fuselage between the root ends of the two wings 3. Three drive shafts 6 extend from the gear 4 and are operatively connected by means of suitable joint couplings each with a propeller unit. The propeller unit 7*a* is situated above the nose 1*a* of the fuselage and has a tractive propeller 8*a*, the axis of which is situated in the plane formed by the vertical and longitudinal axes of the aircraft. The two propeller units 7*b*, of which only one is visible, are anchored each to one of the wings 3, through which the drive shafts also extend; the propeller units 7*b* are provided with pusher-type propellers 8*b*.

The pivoting points of the propeller units 7*a*, 7*b* which are tiltable in planes extending parallel to each other, are designated by *x* in Figure 5; these pivoting points form a triangle the plane thereof being spaced some distance above the centre of gravity S of the aircraft. The upwardly extended plumb line *y* intersects this plane within the said triangle. The casing of the engines 5 is forwardly extended up to the propeller unit 7*a* and extends rearwardly to form a tail unit carrier 9 projecting beyond the rear end of the fuselage.

It is seen in Fig. 5 that the distance of the pivoting axis of the tractive propeller 8*a* from the leading edge of the wing 3 is greater than the radius *r* of the tractive propeller 8*a*. The downflow of air from the upwardly tilted tractive propeller 8*a* thus cannot impinge on the wings 3. As it will be easily realised, the distance *a* must be at least equal to the radius *r* of the propeller in order to ensure that the pivoting axis of the tractive propeller is situated sufficiently far ahead of the leading edges of the wing to avoid any impingement on the wings by the downflow of air during hovering flight.

The control of the described aircraft during normal flight is effected, as usual, by means of the elevators actuated by the control column, of the ailerons actuated by a handwheel, and a side rudder actuated by a foot pedal. During hovering flight, when the control rudders lose their effectiveness due to lack of velocity head, the transmission of control orders, exerted by the operating members, is no longer applied solely

to the rudders, now ineffective, but in addition for instance also to hydraulic control means which adjust or differently load the propeller units according to the desired change in flight position. Changes in position about the vertical axis are effected by relative lateral displacement of the pivoting axes of the pusher propellers; changes in position about the longitudinal axis are effected by differential thrusts of the two pusher propellers while changes in position about the transverse axis are effected by varying the thrusts of the pusher propellers with respect to that of the tractive propeller or vice versa. Variations in flight position about the transverse axis could also be effected by partially tilting the pusher propellers, i.e. to an intermediate inclined position.

The thrust variation of the propellers may be effected by the usual blade adjustment. On the other hand, conventional regulating means could also be provided between each propeller and the common main gear.

It is evident from the preceding explanation that the separation of the heavy power plant from the small propeller units not only results in an advantageous concentration of the weight of the aircraft within the zone of the centre of gravity thereof, but also provides the opportunity of having to tilt only low weights and volumes. In comparison to pivotable drive units, the described arrangement offers the further advantage that no complicated flexible conduits susceptible to trouble are necessary for the fuel supply. The described position of the propeller units with respect to the centre of gravity of the aircraft also exerts a favourable effect upon the stability during the transition from hovering flight to normal flight and vice-versa. The pivoting mechanism for the propeller units can be of light weight and does not cause any substantial increase in the total weight of the aircraft. Furthermore, the thrusts of the individual propellers can be adjusted with respect to each other and maintained constant, more accurately that in the case with propellers forming each a unit together with a separately pivotable driving engine.

Instead of using a front tractive propeller and two rear pusher propellers as shown, one rear pusher propeller and two front tractive propellers could also be provided.

WHAT WE CLAIM IS:—

1. A propeller driven fixed-wing convertible aircraft comprising a fixed driving unit to which three propeller units are operatively connected, said propeller units being mounted for tilting movements in parallel planes with the pivoting points of said propeller units forming a triangle, which for all normal flight altitudes of the aircraft, lies in a plane situated above the centre of gravity of the aircraft, said plane being intersected within said triangle by an upwardly extending plumb line through the centre of gravity.

2. A propeller driven fixed-wing convertible aircraft comprising a fuselage, a fixed driving unit carried thereby, a tiltable propeller unit having a tractive propeller mounted above the nose of the fuselage for upward tilting movement in a plane situated in the longitudinal and vertical axes of the aircraft, two tiltable propeller units having pusher-type propellers mounted on the wings of the aircraft for downward tilting movement in planes extending parallel to the plane of tilting movement of the tractive propeller unit, all three propeller units being operatively connected to said fixed driving unit, the tilting points of the three propeller units forming a triangle, which for all normal flight altitudes of the aircraft, lies in a plane situated above the centre of gravity of the aircraft, said plane being intersected within said triangle by an upwardly extending plumb line through the centre of gravity.

3. An aircraft according to Claim 2, wherein the three propellers are operating at substantially equal load during hovering flight.

4. An aircraft according to Claim 2, formed as high wing airplane, wherein said driving unit includes two engines which are situiated alongside each other on the fuselage between the wing roots and in operative connection with a common gear, each propeller being connected by means of an articulate joint coupling a drive shaft to said gear.

5. An aircraft according to Claim 2, wherein the casing of said driving unit is rearwardly extended beyond the end of the fuselage for the formation of a tail unit carrier, so as to obtain the largest possible landing angle.

6. An aircraft according to Claim 2, wherein side rudder, ailerons and elevators are provided for the control of the aircraft in normal flight, while for the control of the aircraft in a flight with insufficient velocity head thrust variations of the propellers and displacements of their pivoting axes are caused by means of the actuating members of the control rudders.

7. An aircraft according to Claim 6, in which conventional regulating means for varying the thrust of the propellers are provided between the individual propellers and the common gear.

8. An aircraft according to Claim 2, in which the tilting axis of the tractive propeller is spaced ahead of the leading edge of the wings for such a distance that the downflow of air from the upwardly tilted

propeller does not impinge on the wings.

9. An aircraft according to Claim 8, in which the distance separating the axis of the tractive propeller when tilted upwards for hovering flight from the leading edge of the wings at least equals the radius of the propeller.

10. The improved fixed-wing convertible aircraft, substantially as described and illustrated with reference to Figures 1 to 4 and Figure 5 of the accompanying drawings.

MARKS & CLERK.

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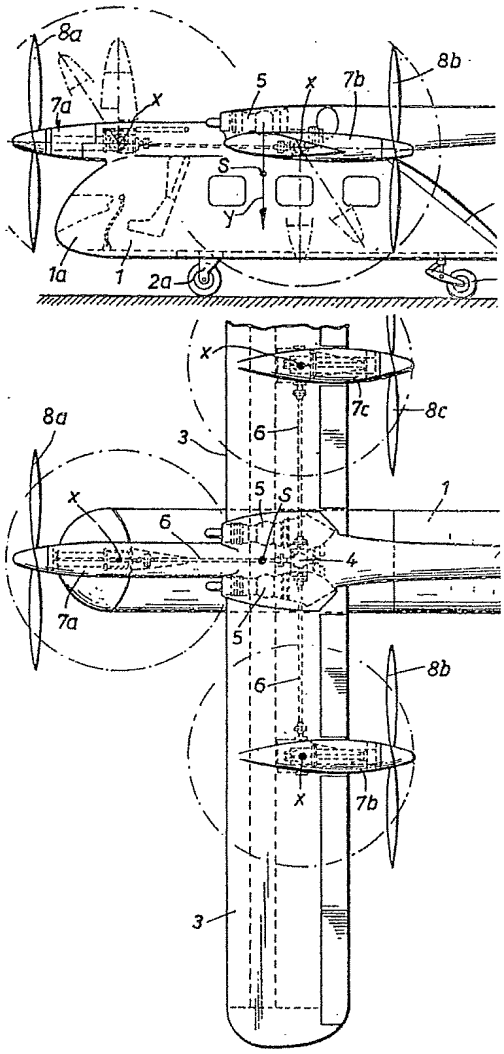
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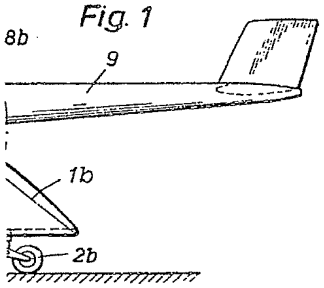
Sheets 1 & 2

Fig. 1



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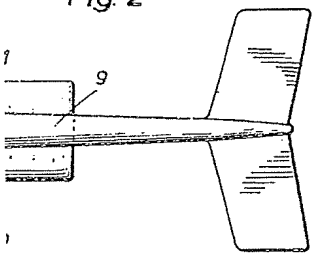

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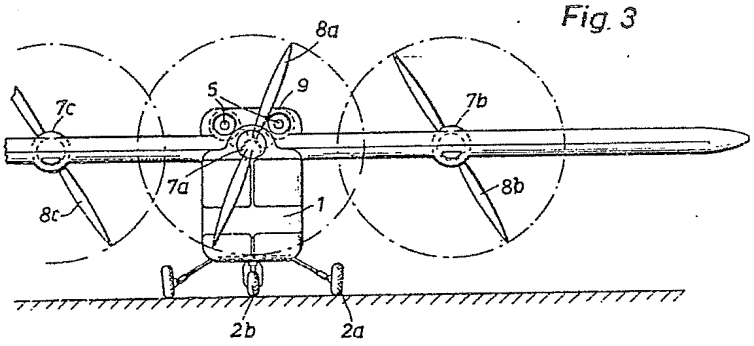

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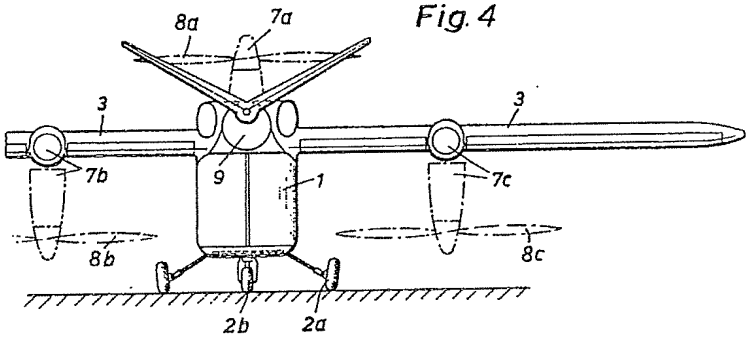

Fig. 5

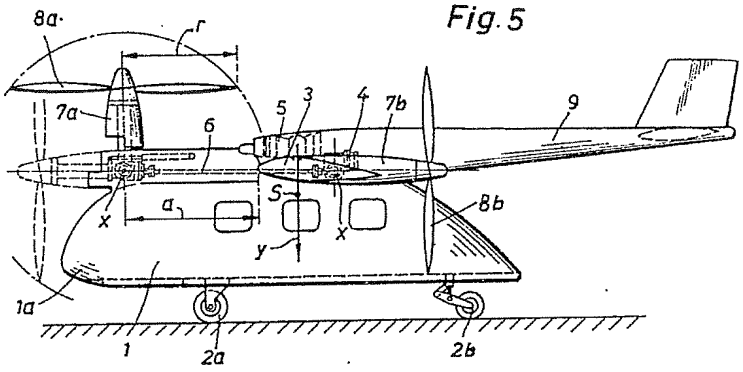

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Fig. 1

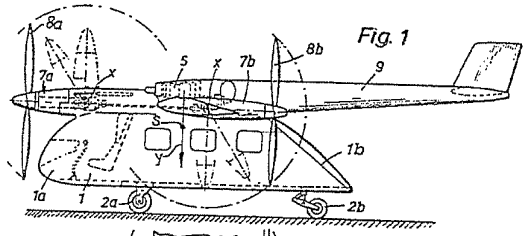

Fig. 2

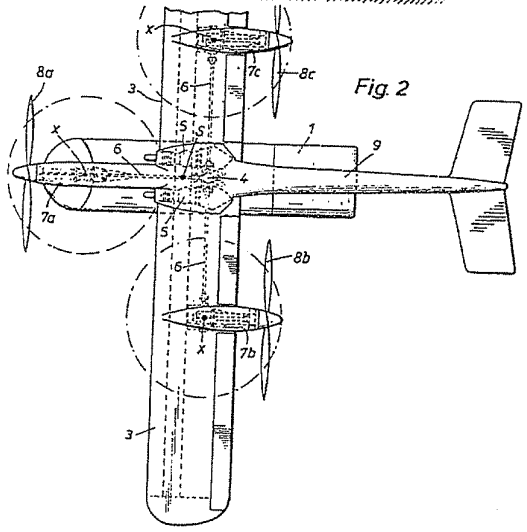

Fig 3

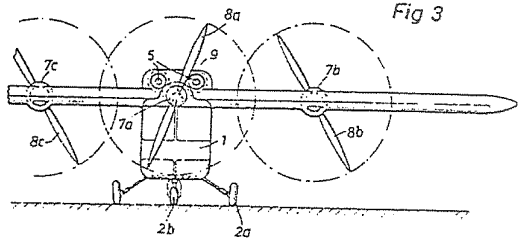

Fig. 4

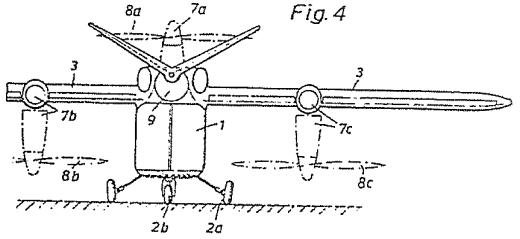

Fig. 5